Cluster-Jet Beam Visualisation with Micro Channel Plates*

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A cluster-jet target will be the first installed internal target for the $\overline{\text{P}}$ANDA-Experiment at HESR/FAIR. To investigate the performance and characteristics of the future cluster-jet installation, a target station prototype in complete $\overline{\text{P}}$ANDA geometry was built up at the University of Münster. The target prototype is routinely operated with hydrogen and achieves target densities of more than $2 \times 10^{15}\,\mathrm{atoms/cm^2}$ at a distance of $2.1\,\mathrm{m}$ behind the nozzle. The target density is reproducible, constant in time, and can be varied over several orders of magnitude with the change of the temperature and pressure before the Laval nozzle [1]. Beside the absolute target density also the reduction of the residual gas background at the interaction point is of highest importance. For this purpose special sized orifices (collimators) are placed close to the nozzle, which define the cluster-jet beam size and shape at the interaction point [2]. The size and shape of the cluster beam can be visualised with a newly developed Micro Channel Plate detector system mounted inside the vacuum at the end of the target beam dump. This MCP system allows for a direct observation of an ionised cluster-jet beam [3]. It consists of an electrically grounded entrance grid

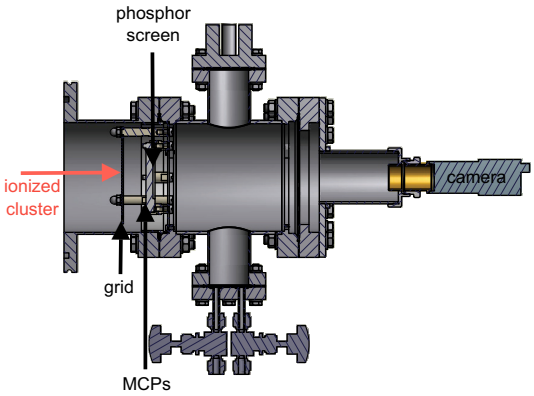

Figure 1: Sectional CAD view of the MCP detector system.

with $2.5\,\mathrm{mm}$ lattice spacing, two MCPs in chevron assembly with an effective diameter of $40\,\mathrm{mm}$ and a phosphor screen combined with a CCD camera (see Figure 1). The clusters in the cluster-jet beam are ionised by an electron beam close to the nozzle and the MCP signals, originating from positively charged clusters, can be observed directly (see MCP images: Figure 2, right). The clearly visible grid structure offers the possibility to estimate the cluster beam size at this position and the image intensity corresponds to the relative cluster beam density distribution. This system

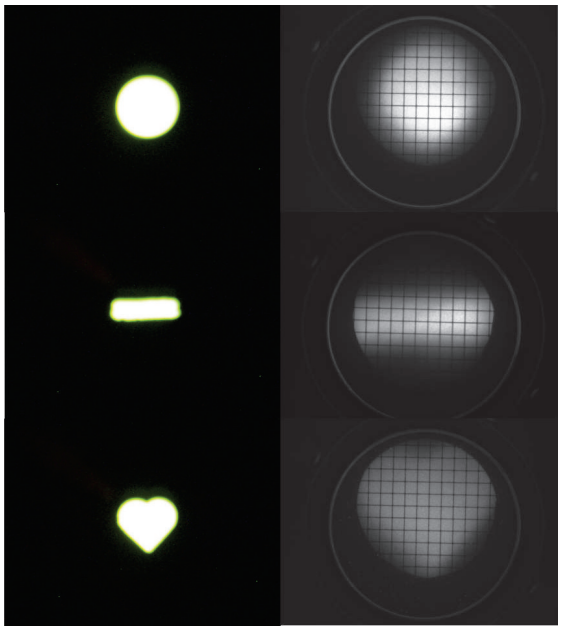

Figure 2: Microscopic view of collimators (left) with round ($\varnothing \approx 0.5\,\mathrm{mm}$), slit ($0.77 \times 0.19\,\mathrm{mm^2}$) and heart (max. width $\approx 0.76\,\mathrm{mm}$) shaped orifice and resulting MCP images (right) of the cluster-jet beam at a distance of approximately $4\,\mathrm{m}$ behind the nozzle.

opens a complete new opportunity to run target beam adjustment checks during target operation. In addition, with this device the visualisation of the interaction region between a cluster beam and an accelerator beam, was successfully demonstrated at ANKE/COSY allowing for new diagnostic tools for vertex point studies. These experimental results are presented in [4] in more detail.

References

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* Work supported by EU (FP7), BMBF, and GSI.

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